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ORIGINAL PAPERS

Dental erosion, an extraesophageal manifestation of gastroesophageal reflux disease. The experience of a center for digestive physiology in Southeastern Mexico

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ABSTRACT

Background: Dental erosion (DE) is the loss of the hard tissues of the tooth produced by the action of gastric juice, pepsin and acid on the dental enamel, its frequency ranges from 5 to 53.41 %. In Mexico there are no reports on the frequency and possible association.

Objective: To establish the prevalence of dental erosion and its relationship to GERD.

Patients and methods: Prospective, observational, descriptive and comparative study was conducted in 60 patients diagnosed with GERD and 60 healthy patients at the Institute of Medical and Biological Research of the Universidad Veracruzana in Veracruz city. Anthropometric characteristics, dietary habits, oral hygiene, alcohol consumption, smoking, ED index and Index of decayed/missing dental pieces/sealed and correlation between severity of ED and GERD were analyzed.

Results: 78.67 % of patients with GERD had ED, 23.33 % corresponded to grade 0, 41.67 % to N1, N2 and 23.33 % to 11.67 % to N3. Predominance of females (2.3:1). The mean age was 50.92 ± 13.52 years. The severity of dental erosion was significantly related to the severity of reflux, halitosis, CPO index and poor eating habits. There was no statistically significant difference in the other variables analyzed.

Conclusions: Dental erosion has a high frequency in patients with GERD and reflux characteristics are directly related to their severity and therefore should be considered as a manifestation of GERD extraesophageal.

Key words: Dental erosion. Gastroesophageal reflux disease. Prevalence.

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BACKGROUND

Gastroesophageal reflux disease (GERD) is a common condition in adults, of chronic course, caused by the rise of gastric contents above the gastroesophageal junction (1).

It has been shown that gastric juice, pepsin and acid can attack tissues not adapted to these substances, causing laryngitis, contact ulcers, subglottic stenosis, laryngospasm, dysphonia, pharyngitis, asthma, pneumonia, and dental diseases (2-4).

Dental erosion is defined as the loss of tooth structure by a chemical process with no involvement of the bacterial flora. Its etiology is associated with intrinsic and extrinsic factors, among which GERD is one of them.

In patients with GERD, the irreversible effect of acid produced by gastric juice on dental enamel can be recognized by the presence of dental erosion, which depends on the duration of the disease and the severity of reflux (5-7).

The demineralization of dental hard tissue by dissolution of apatite crystals can cause the total destruction of the teeth. The location of this damage in patients with GERD is more common in the occlusal and palatal surfaces of the upper teeth and in the buccal and lingual/occlusal surfaces of the lower teeth, because the position of the tongue leads the acid to these surfaces (8-10).

The pattern of severity of erosion is established by assessing the extent of the loss of tooth substance; the most widely used classification is the Erosion Index proposed by Eccles and Jenkins (11), which considers four grades:

– Grade 0: No erosion.
– Grade 1: Loss of enamel without exposure of dentin.
– Grade 2: Loss of enamel with exposure of dentin in less than a third of the tooth surface.
– Grade 3: Loss of enamel with exposure of dentin in more than a third of the tooth surface (11).

The lesions progress slowly and often go unnoticed in the early stages, so it is recommended that patients with GERD are adequately evaluated to establish preventive measures.

Different population groups have reported an association of GERD with dental erosion, the prevalence of which ranges from 5 % to 58.41 %, as shown in table I (8,26-33). In 2012, Vargas et al. published a series of 150 cases of Latin American patients and the two conditions were associated in 30 % (34) of them.

There are no reports for Mexico, so we considered it of interest to carry out the present study, the aim of which was to establish the prevalence of dental erosion in patients with GERD diagnosis, and to determine its possible association and determinant factors.

PATIENTS AND METHODS

A prospective, observational, descriptive and comparative study approved by the ethics committee of the area of Health Sciences at the University of Veracruz, performed in patients who underwent a gastrointestinal examination at the Institute of Medical and Biological Research of the city of Veracruz (Mexico) during the period between January 2011 and December 2012. All patients who agreed to participate after signing an informed consent were asked to complete a validated Spanish version of a questionnaire about laryngeal symptoms for GERD (reflux symptoms index), which consists of 9 questions with 5 possible answers ranging from 0 to 4. It was considered positive when a score of more than 5 was obtained (36).

Two study groups were formed: Group A included patients of both sexes aged over 18 years of age, with no prior drug treatment and a positive questionnaire. They were subjected to endoscopy using the Los Angeles classification to assess the severity of reflux oesophagitis; 24 h stationary pH-metry and impedance were performed using an esophageal catheter and two sensors located at 5 cm and 10 cm from the lower esophageal sphincter (LES) (ZepHr team, Sandhill, Colorado, USA); esophageal manometry was carried out with nasogastric catheter through the LES and subsequent administration of 10 swallows of 5 mL of saline solution (normal value 4.8-32 mm Hg) (Sierra-Given, Los Angeles, Ca , USA); a 14C urea breath test was done to detect *Helicobacter pylori.* Group B included volunteer patients of both sexes over 18 years of age, with a negative result on the GERD questionnaire.

For both groups, the following parameters were registered: Age, gender and body mass index (BMI); food habits were assessed using a questionnaire that included: Alcohol intake (≥ 30 g/day), excessive consumption of citrus (> 1 citrus fruit/day), carbohydrates (≥ 325 g/day), fat (≥ 78 g/day), intake of spicy food and coffee (≥ 3 cups/day). We also recorded smoking status (mild ≤ 5 cigarettes/day, moderate 6-10 cigarettes/day, severe ≥ 11 cigarettes/day), dental hygiene habits, extraesophageal symptoms; a dental clinical examination with intraoral photography was performed; the dental erosion index and the decayed-missing-filled index (DMF) were recorded too, as well as tooth sensitivity, corroborated by a thermal test with exposure to cold and heat (37); salivary pH

Table I. Association of GERD with dental erosion. Published reports

Author	*Year*	*Number of patients*		*Mean age (years)*		*Frequency of dental erosion (%)*	
		With GERD	*Control group*	*With GERD*	*Control group*	*With GERD*	*Control group*
Jarvinen et al. (33)	1988	35				5.0	
Meurman et al. (28)	1994	117		11-49		24.0	
Schroeder et al. (31)	1995	20/30				40.0	
Loffeld et al. (32)	1995	293				32.5	
Gregory et al. (26)	2000	20			> 65	50.0	
Bartlett et al (29)	2001	39	10	15-74	26-46	8.0	0.0
Muñoz et al. (30)	2003	388				47.5	
Moazzez et al. (8)	2004	101	32	44 ± 14.4	42 ± 16.2	58.4	0.0
Oginni et al. (27)	2005	125	100	36.9 ± 9.7	36.9 ± 9.7	16.0	5.0
Vargas et al. (34)	2012	150				30.0	
Roesch et al.	2013	60	60	50.9 ± 13.5	45.5 ± 16.3	78.9	3.3

Table II. Anthropometric variables, dietary habits, alcohol consumption and smoking in patients with GERD (group A) and healthy subjects (group B)

Variable	*Group A n = 60*	*Group B n = 60*	*p*
Age (mean ± SD)	50.92 ± 13.52	45.51 ± 16.39	0.32
Gender F/M (%)	42/18 (70/30)	19/11 (63.3/36.7)	0.63
BMI	26.2 ± 2.7	26.9 ± 4.0	0.20
Carbohydrates * n (%)	49 (81.7)	16 (26.7)	*0.0001*
Fat * n (%)	36 (60.0)	10 (16.7)	*0.001*
Coffee* n (%)	32 (53.3)	12 (20.0)	*0.003*
Spicy food * n (%)	26 (43.3)	12 (20.0)	*0.03*
Citrus *	4 (6.7)	14 (23.3)	*0.03*
Alcohol intake n (%)	18 (30.0)	6 (10.0)	*0.03*
Smoking n (%)	9 (15.0)	4 (6.7)	0.32

F/M: Female/male; BMI: Body mass index; SD: Standard deviation. *Excessive consumption.

Table III. Endoscopic findings, pH-metry and breath test for *Helicobacter pylori* in the group of patients with GERD

Variable	*n (%)*
Endoscopy	
Normal mucosa	12 (20.0)
Esophagitis	48 (80.0)
Grade A	30 (62.5)
Grade B	8 (16.7)
Grade C	8 (16.7)
Grade D	2 (4.16)
Additional findings	
Barrett's esophagus	3 (5.0)
Esophageal stenosis	1 (1.7)
Hiatal hernia	18 (30.0)
Antral gastritis	34 (56.7)
pH-metry	
Acid reflux	42 (70.0)
Alkaline reflux	18 (30.0)
Breath test	16 (26.7)

was measured using a test strip with a sensitivity range of 0-14. The pattern of severity of erosion was established according to the Erosion Index of Eccles and Jenkins (11).

The results were analyzed with descriptive statistics, χ^2 test and Student's t, consisting in relative frequency and average central tendency measurements for obtaining percentages, means and standard deviation. A statistical significance level of $p < 0.05$ was used.

RESULTS

Group A was formed by 60 patients with GERD, and group B by 60 healthy subjects. The mean age for both groups was 48.21 (20-78 years of age) with predominance of female gender (male to female ratio 1:2.3) and no differences between groups. The anthropometric characteristics were similar in both groups and are shown in table II.

Regarding eating habits, we found a significantly higher, excessive intake of carbohydrate and fats, as well as coffee consumption, in group A. There was no difference in the consumption of spicy food and alcoholic beverages (beer intake 64.28 % and liquor 35.71 %), and in smoking (71.42 % mild, moderate 14.28 % and severe 14.28 %), as shown in table II.

The time evolution of GERD was 50.09 ± 32.26 months (7-190 months). Esophagitis was identified in 48 patients (80.0 %).Thirty cases (62.5 %) were classified as grade A, 8 (16.67 %) as grade B, 8 (16.67 %) as grade C and 2 (4.16 %) as grade D. The findings of endoscopy, pH-metry, pH-impedance, and the results of the breath test for *Helicobacter pylori* are shown in table III. Twenty patients (36.67 %) showed extraesophageal manifestations (cough and hoarseness in 40.74 %, cough and posterior nasal drainage in 20.00 %).

Dental erosion was identified in 46 cases (78.67 %) in group A and in 1 case (3.3 %) in group B ($p = 0.0001$); among patients with GERD, 23 cases (48.3 %) were classified as N1, 15 (25.0 %) as N2 and 8 (13.3 %) as N3 (Figs. 1 and 2). The correlation between the degree of dental erosion and the extent of esophagitis is shown in table IV.

The mean age of patients with dental erosion was 49.84 years (48-51 years) and the female gender was predominant with a ratio of males to females of 1:2.3. The excessive intake of carbohydrates and fats did not vary

Fig. 1. Grade 1 dental erosion. One can observe the areas of erosion in the palatal surfaces of the anterior superior teeth, which gives them an opaque appearance.

Fig. 2. Different degrees of dental erosion. Grade 1 erosion can be seen in the occlusal surfaces of the lower teeth, grade 2 erosion in the occlusal surfaces of the posterior teeth on the right side.

significantly in the subgroups. Intake of spicy food and excessive coffee consumption predominated in the N0 and N1 subgroups. Excessive consumption of citrus was recorded only in 4 cases (6.6 %). Alcohol intake was predominant in the N1 and N2 subgroups, and smoking in the N0 and N1 subgroups (Table V).

Oral hygiene habits showed no statistically significant difference (p = 0.82) between both groups. The additional use of mouthwashes and dental floss was reported by 52 % in group A and 39 % in group B. There were more patients with halitosis in group A (73.3 %) compared with group B (30.0 %) (p = 0.01).

The dental sensitivity test was positive in 25 cases (41.67 %) in group A and in 16 cases (50.0 %) in group B (p = 0.37), with predominance in the N2 subgroup (64.3 %). The DMF index in group A was 17.61 ± 5.70, and 11.93 ± 5.22 in group B (p = 0.0001). Salivary pH was 6.14 ± 0.65 in group A and 6.26 ± 0.61 in group B. In both groups, the pH oscillated between 5.0 and 8.0 (p = 0.97) (Table VI).

DISCUSSION

Dental erosion is a multifactorial disease that occurs more frequently in elderly patients, associated with bad hygiene/dietary habits, but especially with exposure to aggressive agents, among which acid plays a major role. It has been reported that the prevalence of dental erosion in patients with GERD varies from 5.00 % to 58.41 % (8,24-34), which we corroborated in our series of patients, were a prevalence of 78.9 % was found, higher than the prevalence reported by other authors (8,28,30,31). This is directly related to the severity and duration of the disease; in our cohort, the average time of evolution was 50.09 ± 32.26 months, and the presence of acid reflux was demonstrated in 70.0 % of cases by pH-metry (8,19-22,24,34). By comparing the degree of dental erosion with the severity of esophagitis, we found that 75.0 % of the patients with grade N0 and N1 had normal mucosa or grade A esophagitis, whereas patients with N2 and N3 DE were associated with greater frequency to esophagitis stages C and D; the difference was statistically significant (p = 0.021).

The intake of certain foods has been linked to the presence of reflux because they decrease the tone of the lower esophageal sphincter and slow gastric emptying. Regarding dietary habits, we found that excessive consumption of fats, carbohydrates, spicy food and coffee intake in the group of patients with GERD was higher than in the control group (p = 0.0001 and 0.03 respectively) .Citrus consumption was higher in group B (p = 0.03) but no dental erosion was found in them.

Group A had an average salivary pH of 6.14 ± 0.65, and group B 6.26 ± 0.61 (p not significant). However, this cannot be considered a valid measurement because it was performed during a reflux episode.

Although the relationship between other dental diseases and GERD has not been accurately documented, 73.3 % of our patients had halitosis, a higher frequency than in controls (p = 0.001) and than the frequency reported in the general population. Thus, the DMF index and dental sensitivity were higher in group A, which may have been due to poor hygiene habits in our population.

The results of our study suggest the involvement of acid reflux in the etiology of dental erosion; however, we believe that the number of cases studied is too small and that it should be expanded to confirm our findings.

Table IV. Correlation of the degree of esophagitis with the degree of dental erosion in patients of group A

Degree of dental erosion	*Degree of esophagitis (n = 60)*				
	Normal mucosa	*A*	*B*	*C*	*D*
	n (%)	*n (%)*	*n (%)*	*n (%)*	*n (%)*
N0	7 (11.7)	6 (10.0)	1 (1.7)	0 (0)	0 (0)
N1	2 (3.3)	15 (25.0)	3 (5.0)	3 (5.0)	0 (0)
N2	0 (0)	9 (15.0)	3 (5.0)	3 (5.0)	0 (0)
N3	3 (5.0)	0 (0)	1 (1.7)	2 (3.3)	2 (3.3)
Total	12 (20.0)	30 (50.0)	8 (13.3)	8 (13.3)	2 (3.3)

Table V. Frequency of the variables analyzed and the different degrees of dental erosion, according to the Eccles and Jenkins index

	Degree of dental erosion in group A n = 60 cases				
Variable	*N0*	*N1*	*N2*	*N3*	*p*
Number of cases (%)	14 (23.33)	25 (41.67)	14 (23.33)	7 (11.67)	
Age (years)	49.96 ± 16.03	50.89 ± 16.03	49.95 ± 16.03	48.59 ± 16.13	
Gender F/M (%)	8/6 (57.1/42.9)	18/7 (72.0/28.0)	11/3 (78.6/21.4)	5/2 (71.4/23.6)	
Carbohydrates * n (%)	12 (85.7)	20 (80.0)	12 (85.7)	5 (71.4)	0.026
Fats * n (%)	9 (64.3)	13 (52.0)	10 (71.4)	4 (57.1)	0.316
Spicy food * n (%)	6 (42.8)	14 (56.0)	5 (35.7)	1 (14.3)	*0.003*
Citrus * n (%)	1 (7.1)	1 (4.0)	1 (7.1)	1 (14.3)	1.000
Coffee * n (%)	8 (57.1)	15 (60.0)	6 (42.8)	3 (42.9)	*0.021*
Alcohol * n (%)	4 (28.5)	8 (42.9)	5 (35.7)	1 (14.3)	0.135
Smoking n (%)	2 (14.3)	5 (20.0)	1 (7.1)	1 (14.3)	0.189
Acid reflux n (%)	9 (64.3)	16 (64.0)	11 (78.6)	6 (85.8)	0.232
Non-acid reflux n (%)	1 (7.1)	9 (36.0)	5 (35.7)	3 (42.58)	0.051
DMF index	17.55 ± 6.02	17.61 ± 6.02	17.55 ± 6.02	16.25 ± 6.13	
Halitosis n (%)	8 (57.1)	20 (80.0)	11 (78.6)	5 (71.4)	*0.003*
Dental sensitivity n (%)	6 (42.8)	8 (42.9)	9 (64.3)	2 (28.6)	0.204
Good oral hygiene n (%)	7 (50.0)	13 (52.0)	9 (64.3)	3 (42.9)	0.090
Poor oral hygiene n (%)	7 (50.0)	11 (44.0)	5 (35.7)	3 (42.9)	0.146

F/M: Female/male. *Excessive intake.

We can conclude that in our population dental erosion has a high frequency in patients with GERD and that the characteristics of reflux are directly related to the severity of DE and, therefore, that it should be considered as an extraesophageal manifestation of reflux. We recommend that DE is detected in a timely manner in order to control it and prevent it from causing extensive dental damage.

Table VI. Main findings in the oral cavity of patients with GERD compared with patients without GERD

Variable	*Group A n = 60*	*Group B n = 60*	*p*
Good oral hygiene n (%)	34 (56.7)	32 (53.3)	0.82
Poor oral hygiene n (%)	26 (43.4)	28 (46.7)	0.82
Halitosis n (%)	44 (73.3)	18 (30.0)	*0.001*
Dental erosion n (%)	46 (78.9)	2 (3.3)	*0.0001*
DMF index	17.61 ± 5.70	11.93 ± 5.22	*0.0001*
Salivary pH-metry	6.14 ± 0.65	6.26 ± 0.61	0.97
Dental sensitivity n (%)	25 (41.67)	30 (50.0)	0.37

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